

*Part 7*

## SIALIDIDAE OF NORTH AND SOUTH AMERICA

BY K. C. DAVIS

The study leading to the preparation of this paper was made chiefly while the writer was a graduate student at Cornell University, 1898-1900. The writer is under great obligation to Prof. J. H. Comstock and Mr A. D. MacGillivray, of Cornell, for much aid and encouragement; to Mr Samuel Henshaw, of the Museum of Comparative Zoology, for use of the rich collections made by Dr Hagen and others; to Mr William H. Ashmead for the examination and loan of valuable specimens from the United States National Museum; to Dr Henry Skinner for kindness shown while examining specimens in the Philadelphia Academy of Natural Sciences; and to a number of correspondents and others who have given information in regard to distribution, or lent specimens for examination, or aided in other ways.

The family *Sialididae* is of peculiar interest both on account of the large size and the striking appearance of most of its members and because it includes some of the most generalized members of the order Neuroptera.

As is often the case with more primitive groups, the family is a small one, including only four living genera; but it has a world-wide distribution. Fortunately for our purposes, all of the genera are found in our country, and representatives are common in many sections. The four genera are represented in the two Americas by only 32 species.

## Family SIALIDIDAE

The members of this family differ from all other Neuroptera in having the hind wings broad at the base, the anal area being folded like a fan when the insect is at rest. They differ from their nearest allies, the Raphididae, in the form of the prothorax, which is quadrangular, while in the Raphididae it is generally elongated. They also differ from most other Neuroptera in being aquatic in their larval state.

Though the family contains only four living genera, these represent two quite distinct lines of development. So well marked are these that they may be considered as representing two subfamilies, which may be designated as the Sialidinae and

the Corydalinae. The more important of the distinctive characters of the subfamilies are included in the following tables.

#### TABLE TO SUBFAMILIES

##### *Adults*

- a* Accessory veins of radial sector on the front side of vein  $R_3$  [fig. 23]; ocelli wanting; fourth segment of tarsi prominently bilobed ..... Sialidinae
- aa* Accessory veins of radial sector on the posterior side of vein  $R_2$  [fig. 24, 25, 26]; ocelli three; fourth segment of tarsi obscurely or not at all lobed.....Corydalinae

##### *Larvae*

- a* Anal prolegs wanting; lateral filaments only seven pairs, and distinctly jointed..... Sialidinae
- aa* Anal prolegs one pair, provided with claws; lateral filaments eight pairs, slightly or not at all jointed. Corydalinae

##### *Egg masses*

- a* Eggs always in one layer [pl.51]..... Sialidinae
- aa* Eggs in more than one layer [pl.52].....Corydalinae

##### *Eggs*

- a* Distal portion of micropylar projection cylindric, twice as long as broad, joined to the egg by a short neck [fig.20]..... Sialidinae
- aa* Distal portion of micropylar projection nearly globular, joined to the egg by a long neck [fig.20].....Corydalinae

#### Subfamily SIALIDINAE

The adult members of this subfamily are all much smaller than those of the Corydalinae; the ocelli are wanting; the accessory veins of the radial sector in both pairs of wings arise from  $R_3$  and extend forward, giving the insect a very characteristic mode of flight; the fourth segment of the tarsi is prominently two lobed.

The subfamily includes a single genus *Sialis*.

##### *SIALIS* Latreille

Besides the characters of the subfamily given above, the following additional generic characters should be added:

**Adult.** Body and wings black or ferruginous; prothorax quadrangular, almost equal in width to the head, not so long as the mesothorax and metathorax combined; ocelli wanting; an-

tennae filiform, about equal to the body in length; wing expanse 20 to 40 mm, hind wings somewhat less.

The males are usually a little smaller than the females.

**Larva.** Suited for aquatic life. 20 to 30 mm long when full grown; tapering from head to the caudal end of abdomen; head and thorax yellow on dorsal side, mesothorax and metathorax bearing some light brown markings; the appendages of the head

and the eyes brown; abdominal segments brown on the dorsal side and somewhat on the ventral side; first seven segments of the abdomen each supplied with a pair of five jointed, lateral appendages, evidently tracheal gills, each with two rows of delicate hairs [fig. 20]; within these thin, white walled, gill appendages are seen finely divided trachea; from the last abdominal segment is a single caudal appendage similar to but longer than the lateral ones and not jointed and supplied with *two* large branching trachea and *four*

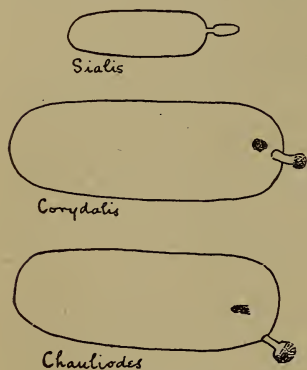


Fig. 20 Eggs of Stalididae

rows of delicate hairs. This structure may indicate, as Miall has suggested, that the caudal appendage may have been formed by the fusion of two lateral appendages. There is a pair of minute spiracles present on each abdominal segment except the last. Each antenna has five segments, but the basal one is often obscure.

On the dorsal side of the larva of *S. infumata* the segments are translucent, often showing the viscera. The lateral lobes of the abdominal segments are so transparent that the particles of blood may be seen and the pulsations of the heart may be counted. I found the number of pulsations to vary somewhat, but the average is about 10 a minute. Oenocytes with the finest branches of tracheoles leading to them are so plainly visible that they can be photographed.

**Eggs.** The eggs of *S. lutaria*, the most common species in Europe, have been briefly described by Miall [1895] as "dark brown, several hundred in one cluster, cylindrical with rounded ends, and closely packed together; from the free end of each egg a small, pointed and whitish projection is given off." The eggs of our most common species, *S. infumata*, have been found in great numbers. They agree with the above description. The "whitish projection," or micropylar projection, is not knobbed at the end, but the distal portion, which may be the micropylar surface, is cylindric in form, with a short, narrow pedicel at the point of attachment to the eggshell.

The masses are often quadrangular but are variable in outline, and are not coated with any protecting material. Several masses are very commonly found near each other; in one case about 150 masses were found within an area 6 by 12 inches; and the remains of the masses of former years are also found near the fresh eggs if the place be a suitable one. The eggs are all placed in a slanting position, i. e. not perpendicular to the surface of attachment; and are all parallel to each other, in one layer, with the micropylar projection outward. Exact counts and estimates show that the number of eggs in a mass is usually from 200 to 500 [pl. 51].

### Life history of *Sialis infumata*

It is an interesting sight to see a female depositing her eggs. This I have witnessed on several occasions. She deposits an entire row of 10 to 20 eggs and then begins another row; as the rows accumulate, she moves backward over the mass to reach the place for the succeeding rows; thus her body and wings cover the egg mass till it is completed. The eggs are always deposited over water or in a place where the young larvae will naturally fall into water. I found them on the under sides of boat landings, on the under and vertical sides of bridges, on stones projecting above the water of creeks and lakes. Stagnant pools are not attractive to members of this genus. The adults do not seem to select the twigs or leaves of trees and shrubs when such objects as those above mentioned are accessible. When a high bridge is selected by the adults, on which to deposit their eggs, they know where the limits of the running water are, and deposit the eggs within those limits.

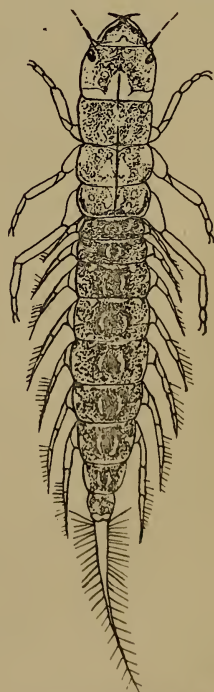


Fig. 21 Larva of *Sialis infumata* x3 (After Needham)

After seeing females deposit their eggs and after noting the dates when other new eggs were deposited, say on a given rock,

it was an easy matter to determine the length of the egg period. By visiting the region daily till the hatching took place, the period was found to be nine or ten days. Hatching seems to take place only in the dark. In the region of Ithaca in 1899, the hatching took place mostly during the first half of June. It was observed that many masses of eggs never hatch. Some masses of old eggs, apparently dried and dead, were found to hatch when placed in a moist bottle in the collector's pocket. In several cases these were found to hatch within an hour from the time they were taken. The only explanation is that they had become too dry, and the moisture in the bottle helped to soften the eggshells so that the young larvae could break through.

**Larva.** The young larvae when hatched differ somewhat in appearance and structure from the older larvae above described, specially in having relatively longer filaments and legs, and larger heads with larger mouth parts and only two jointed antennae.

Miall [1895], who has made a study of *S. lutaris*, states that the larvae live about a year in streams with muddy bottoms. My observation of *S. infumata* indicates that the larval life is at least two years. However, the exact length is yet to be determined more certainly. Miall states that he found freshly hatched larvae of his species "wriggling out on leaves many yards from the nearest stream or pond." I have seen nothing like this, as *S. infumata* always places the eggs where the young when hatched will fall directly into the water.

The larvae live in the bottoms of streams which are either muddy or sandy. I have most often found them in deep sand or gravel, perhaps 6 inches or a foot below the bed of the stream. At this depth the larvae of *Corydalis*, perhaps their worst enemies, seldom find them. Tests made as to their food habits show that they are carnivorous, and will eat soft bodied caddis worms, small *Chauliodes* larvae and even eat one another very readily. The larvae do not come to the surface nor abandon their aquatic life till nearly ready to pupate. When captured, they often eject a black liquid from the mouth. This means of defense is much more commonly used by them than by the larvae of *Chauliodes* and *Corydalis*.

**Pupa.** The pupae of this species have only once been found in their natural conditions by the writer. Prof. J. H. Comstock first found them buried several inches in the earth some yards

from water [fig. 22]. Miall's observations of *S. lutaria* quite agree with this, and he further states that the adult emerges after two or three weeks.

**Adults.** These have already been described above. They are very awkward fliers and are easily caught even without a net. This quite agrees with the generalized form of the wing venation [fig. 23]. In fact, the adults when approached, will often run rather than attempt to fly. It is probable that the insect lives in the winged form only a few days. All specimens taken were found to die within three days. The dates on which the adults have been collected near Ithaca range from May 13 to June 16, through a series of years. They are diurnal in their habits and seem to prefer bright sunshine. I have found them most abundantly in their egg-laying places at midday, though they also frequent the same places and are active till almost dark.

The short life taken with the fact that the mouth parts of the adult are very poorly developed, would indicate that the adults do not take food. It was reported to Dr Hagen and to the national museum some years ago that the adults of *S. nevadensis* were very injurious to grapevine leaves. This is the only case of injury yet charged to any members of the family, and may be a false charge. On the other hand, the adults, flying near



Fig. 22 Pupa of *Sialis infumata* x3  
(After Needham)

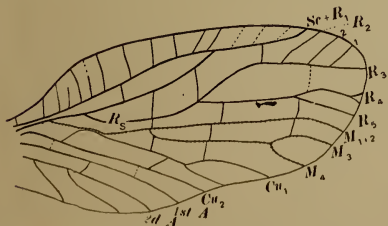


Fig. 23 Fore wing of *Sialis infumata* x4

#### KEY TO SPECIES OF SIALIS

- a Body and wings black or blackish
- b Head black with flat, shining streaks and spots yellowish

the surface of water, serve as an abundant supply of food for fishes.

- c* The proximal cross vein between  $R_1$  and  $R_s$  opposite the proximal cross veins between  $R_s$  and  $M$ ; fore wings rarely with more than two accessory veins arising from  $R_3$ ; cheeks yellowish ..... 1 *infumata*
- cc* The proximal cross veins between  $R_1$  and  $R_s$  distinctly distad of the proximal cross vein between  $R_s$  and  $M$ , and which is generally opposite the first fork of *media*; fore wing never with less than three accessory veins arising from  $R_3$ ; cheeks black..... 2 *fuliginosa*
- bb* Head black in front with a broad orange band behind ..... 3 *nevadensis*
- aa* Body either black or ferruginous, wings pale ferruginous, or pale fuscous
- b* Head black in front, with broad orange band behind; body black..... 4 *morrisoni*
- bb* Head yellow, orange, or reddish, with or without dark markings; body never quite black
- c* Front of head without dark stripes..... 5 *americana*
- cc* Front of head marked with black stripes, or suffused with fuscous
- d* Antennae stout, head with two black stripes; femora yellowish; eyes normal..... 6 *bifasciata*
- dd* Antennae slender; head with a long median line, suffused with fuscous in front; femora blackish fuscous; eyes unusually prominent 7 *chilensis*.

## DESCRIPTION AND GEOGRAPHIC RANGE OF SPECIES

### 1 *S. infumata* Newman

- 1838 *Sialis infumata* Newman, Ent. Mag. 5:500
- 1853 *Sialis infumata* Walker, Cat. Brit. Mus. Neur. p.195
- 1861 *Sialis infumata* Hagen, Synopsis Neur. N. Am. p.188
- 1863 *Sialis infumata* Hagen, Ent. Soc. Phila. Proc. 2:181
- 1863 *Sialis infumata* Walsh, Ent. Soc. Phila. Proc. 2:261
- 1892 *Sialis infumata* Banks, Am. Ent. Soc. Trans. 19:357
- 1897 *Sialis concava* Banks, Am. Ent. Soc. Trans. 24:22
- 1901 *Sialis infumata* Needham, N. Y. State Mus. Bul. 47, p.542, pl.29

Black; head a little narrower than the prothorax, but not narrowed posteriorly, between the eyes convex to concave, caudal half of head with ferruginous and shining streaks and spots, similar spots between the eyes, more or less conspicuous; antennae black, rather slender; prothorax rounded on the anterior angles, the sides of dorsal aspect with a few impressed points; legs and feet black; wings nearly black, the veins thick and

black;  $R_3$  of fore wings with rarely more than two simple or forked branches; the proximal cross veins of  $R_1-R_s$  and  $R_s-M$  are opposite. Length to tip of wings 10 to 15 mm; alar expanse 22 to 26 mm. Males are the smaller.

*S. concava* Banks was said to differ in being always concave between the eyes. This, however, is not a constant character as shown by an examination of hundreds of specimens. Fourteen specimens in the Harvard collection under this label are apparently males of *S. infumata*.

A species of very wide distribution: arctic America, Quebec, Nova Scotia, throughout New England and New York, New Jersey, Maryland, Washington D. C., Washington N. C., Ohio, Detroit Mich., Galena and Galesburg Ill., Saskatchewan region, in Minnesota at Minneapolis and St Cloud, in California at Lake Tahoe, Placer co., San Geronimo, San Celito.

## 2 *S. fuliginosa* Pictet

1836 *Sialis fuliginosa* Pictet, Ann. Sci. Nat. pl.3, fig.6

1839 *Sialis fuliginosa* Burmeister, Handb. Ent. 2:947

1856 *Sialis fuliginosa* Brauer, Verh. Zool. Bot. Ges. p.397

1857 *Sialis fuliginosa* Brauer & Low, Neur. Aust. p.52

1865 *Sialis fuliginosa* McLachlan, Ent. Mo. Mag. 2:107, fig.1; and 1866, 3:95

1868 *Sialis fuliginosa* McLachlan, Ent. Soc. Lond. Trans. 152:8, fig.2

This European species, not formerly reported in America, differs from *S. infumata* in several points: larger, the alar expanse of the female being 38mm and the three brown spots between the antennae relatively much larger; much more densely pilose throughout, even slightly so on the hind wings; compound eyes ferruginous with several black spots or areas; the proximal cross vein  $R_1-R_s$  is distinctly distad of the proximal cross vein  $R_s-M$ , the latter generally opposite the first fork of media. In *S. infumata* the yellow infusion around the eyes is usually quite distinct, while in *S. fuliginosa* it is much less so. Fore wings never with less than three accessory veins arising from  $R_3$ ; these are either simple or forked.

Six specimens collected by Morrison 1878, Reno Nev., one from Morris county, Cal., two from Mendocino Cal., and two

from Webber lake, Cal., agree with this characterization, and are like the European specimens in the Museum of Comparative Zoology.

### 3 *S. nevadensis* n. sp.

Body black; head not narrowed behind, black with orange band clear across the caudal half and reaching around under the eyes to the antennae, smooth streaks and spots of the same color in the orange band above, no such spots between the antennae; eyes black; prothorax hardly narrower than the head, black, not at all marked with the orange color, anterior angles obtuse; antennae black, very slender; feet and legs black; legs pilose; wings black, translucent, either shining or dull, veins darker if possible; Sc-R<sub>1</sub> cross veins only one or two; R<sub>2</sub> with two simple or forked branches. Length to tip of wings 18 to 25 mm; alar expanse 38 to 40 mm.

Collected by Morrison at Reno Nev., 1878. In Nevada county, Cal., June 12, 1880, said to be "very injurious to grapevine," or "injuring grape leaves." Types in United States National Museum catalogue no. 5177.

### 4 *S. morrisoni* n. sp.

Body black; head and thorax shaped and marked as in *S. nevadensis*; legs and feet ferruginous; wings ferruginous, veins hardly darker; venation as in that species. Length to tip of wings 20mm; alar expanse 40mm.

Collected by Morrison, Reno Nev., 1878. Type in Museum of Comparative Zoology.

### 5 *S. americana* Rambur

1842 *Semblis americana* Rambur, Hist. Nat. Neur. p.447

1853 *Sialis ferrugineus* Walker, Cat. Brit. Mus. Neur. p.195

1861 *Sialis americana* Hagen, Synopsis Neur. N. Am. p.188

1892 *Sialis americana* Banks, Am. Ent. Soc. Trans. 19:357

General color ferruginous; head narrower behind; eyes black; caudal half of head with flat streaks and spots shining and surrounded with ferruginous; antennae ferruginous; anterior angles of prothorax square; prothorax a little narrower than the head, sides with yellowish impressed punctures; femora ferruginous; feet fuscous; wings pale ferruginous, the veins

darker;  $R_3$  only one branched; Sc- $R_1$  cross vein only one. Length to tip of wings 12 to 14 mm; alar expanse 24 to 26 mm.

Reported from Georgia and Pennsylvania. One specimen in the Museum of Comparative Zoology. Hagen [1861] is my authority for placing the name given by Walker as synonymous with the above.

6 *S. bifasciata* Hagen

1861 *Sialis bifasciata* Hagen, Synopsis Neur. N. Am. p.188

General color ferruginous; head not narrowed posteriorly, color orange with two broad, black stripes, shining orange streaks and spots behind; antennae stout, black, pilose; prothorax orange, anterior angles obtuse, sides with broad fuscous somewhat shining stripe and flat points; femora yellowish with base fuscous; feet fuscous; wings pale fuscous, somewhat shining, front ones obscure on costal margin, veins pale fuscous. Length to tip of wings 10 to 12 mm; alar expanse 17 to 20 mm.

Cuba.

7 *S. chilensis* McLachlan

1870 *Sialis chilensis* McLachlan. Ent. Mo. Mag. 7:145

Fusco-nigra, abdomen black; head reddish, an impressed median longitudinal line reaching the hind margin, joining a sinuate line in front before the antennae, frontal part and at sides of median line suffused fuscous, a fuscous spot on each side below the eyes; labrum truncate in front, testaceous; eyes larger and much more prominent than in other species; thorax blackish fuscous, very narrow, clothed with a short pubescence; antennae and palpi black; legs and feet blackish fuscous, short pubescent; claws and beneath lobes of fourth tarsal joints testaceous; wings smoky, somewhat shining, membrane with short, black hairs, pale space in each wing below the juncture of R with Sc; veins black, costal area narrow, slightly dilated, with about seven C-Sc cross veins,  $R_3$  with but one forked branch; front wings long and narrow, apex long elliptic; hind pair slightly broader.

Chile.

*S. lutaria* Linn. is the most common European member of the genus. There are seven specimens in the Hagen col-

lection. The alar expanse of the males is 25 mm and of the females 35 mm. The antennae are nearly equal to the expanded fore wings but are variable. The compound eyes are marked about as in *S. fuliginosa*. The species is much like *S. infumata* in most particulars, but there are only one or two Sc-R<sub>1</sub> cross veins of the fore wings; R<sub>3</sub> has two simple or forked branches going forward, and there is no yellow infusion spreading around the eyes; the legs are ferruginous, not black. Larvae in alcohol have abdomen black with a row of yellow markings down the middle of the dorsal side. The pupa has no abdominal appendages, and is very light yellow all over, and has a whorl of hairs over each abdominal segment.

*S. sibirica* McLachlan. Four specimens with this label are in the Hagen collection, but they do not differ from the specimens of *S. lutaria*.

#### Subfamily CORYDALINAE

Here we find the accessory veins of the radial sector in both pairs of wings arising from R<sub>2</sub> and extending backward. The insects are provided with three ocelli. The tarsi are not at all lobed or sometimes slightly so. Anal prolegs and claws are present in the larvae. Three genera are included in this subfamily, *Chauliodes*, *Neuromus*, and *Corydalis*.

#### TABLES TO GENERA

##### *Adults*

- a* Mandibles when closed largely concealed by the labrum; mandibles of male hardly more elongated than those of the female; white dots rarely found within the cells of the wings
- b* Media of the fore wings with only two branches [fig.24]; lateral margins of the head not toothed [pl.52]....*Chauliodes*
- bb* Media of the fore wings always with more than two branches [fig.25]; lateral margin of the head bidentate or unidentate or only slightly unidentate in *N. corripens*.....*Neuromus*
- aa* Mandibles when closed not concealed by the labrum; mandibles of male enormously elongated; white dots always found in some of the cells of the fore wings.....*Corydalis*

##### *Larvae*

- a* Tracheal gills wanting; last pair of spiracles raised on prominent conical folds or long respiratory tubes.....*Chauliodes*

aa Tracheal gills on ventral side of the first seven abdominal segments; last pair of spiracles not raised on respiratory tubes nor on conical folds

b Antennae with five segments.....*Neuromus*

bb Antennae with six segments.....*Corydalus*

*Egg masses*<sup>1</sup>

a Mass not covered.....*Chauliodes*

aa Mass normally covered with a whitish coat of albuminous matter .....*Corydalus*

*Eggs*

a Micropylar projection distinctly at one side of apex; neck less than half the width of micropylar surface [fig.20]...*Chauliodes*

aa Micropylar projection near the apex; neck nearly as broad as micropylar surface [fig.20].....*Corydalus*

**CHAULIODES** Latreille

**Adult.** Smaller than *Corydalus*; body 20 to 40 mm long, the male often being smaller than the female. Prothorax quadran-

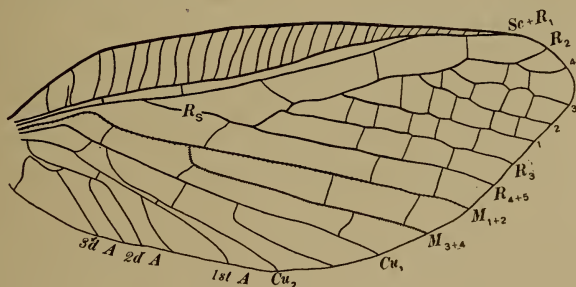


Fig. 24 Fore wing of *Chauliodes* x3

gular, narrower than the head, and shorter than the mesothorax and metathorax combined; no toothed angle on sides of the head; three large approximate ocelli facing at about 120° from each other; antennae moniliform serrate, pectinate, or flabellate; mandibles not prominent, concealed by the labrum when closed; wings numerous veined, the accessory veins of the radial sector extend backward from  $R_2$  in both pairs of wings; radial sector with four to six branches, and medius always with only two branches [fig. 24]; cross veins between all the branches of radius varying in different species, from seven to about 20; hind wings broad at base and folded in the anal area when at rest; alar expanse 50 to 90 mm; tarsi cylindric, five jointed; caudal appendages conical, stout, inferior pair often simple in both sexes, superior pair simple in female and slightly prehensile in male.

<sup>1</sup>Eggs of *Neuromus* have never been described.

**Larva.** Aquatic; about half as large as the larva of *Corydalis* when full grown; dark fuscous with black or dark head and prothorax; clavate projections on the skin present, similar to those found on larva of *Corydalis*, but of a light brown color and much less distinct. Last four or five segments of the abdomen tapering toward the caudal end of the body; first eight segments of the abdomen each with a pair of whitish lateral filaments 6 to 8 mm long, which may serve as tracheal gills in the younger larvae; these are sometimes indistinctly five jointed and are sometimes only slightly clothed with hairs; no ventral tufts of tracheal gills present; spiracles are found on a fold between the prothorax and the mesothorax and on each of the first eight abdominal segments, the last pair being raised more or less on prominent conical folds or terminating a pair of slender tubes. These tubes, in the species where they are present, are very contractile and vary in length at times from about 5 to 12 mm [see Lintner, 1893, pl.1]. On the last segment is a pair of anal prolegs, each with a pair of claws and a lateral filament which is decidedly hairy; antennae with five segments, the first segment often being retracted.

Several larvae in the Museum of Comparative Zoology are much like the ones I have formerly collected. Eight collected at Cambridge have no central black stripe on dorsal aspect of abdomen and thorax. One sent by H. Edwards from California has last pair of spiracles nearly sessile. The lateral filaments are unusually long and rather distinctly jointed. Specimens collected in Kentucky by Sanborn have last pair of spiracles nearly sessile, and the last pair of lateral filaments very long, reaching much past the anal ones. The last pair of respiratory tubes are clearly shown, and are confluent or adjacent at their base on specimens collected at Brookline by Mr Henshaw.

**Eggs.** The eggs of *Chauliodes* have been described and photographed by Dr Needham [1901]. Riley [1879] briefly compared them with eggs of *Corydalis* in these words: "Eggs of *Chauliodes* have a larger tubercle or stem on the top, and are not covered with white, albuminous material as are those of *Corydalis*." These are the only references to the eggs which I have found in literature.

The masses are shaped not unlike the masses of *Corydalis* eggs, but are more variable in size and shape. They are reddish brown, with no protective coating over the mass. The eggs of a mass are usually placed in three layers of unequal size, the smallest layer being on top; the longer axis of each egg is parallel to the surface to which the mass is attached [pl. 52, fig. 2].

The brown or pink micropylar projection is knobbed, and is placed a little to one side of one end of the egg; otherwise the egg is cylindric, with rounded ends [fig. 20].

### Life history of *Chauliodes*

The eggs were first found by the writer on the underside of a boat landing built of wood, on the southeast shore of Cayuga lake near Ithaca N. Y., June 14, 1899, while searching for them. In this case there was but a single mass, freshly deposited within two feet of the surface of the water. The second lot, found June 16th in Coy glen, was composed of three groups or clusters, each cluster being made up of about 30 or 40 egg masses. Each mass has from 1000 to 2000 eggs. These were all within a radius of 2 feet on a large glacial rock, about 2 or 3 feet above running water. Farther up the glen in many places I found single masses on small rocks overhanging the water. Some of these were 10 or 15 feet above the water. In one case a mass was found on an overhanging limb of a tree. Mr A. D. MacGillivray has frequently found them on leaves and limbs. Stones seem to be preferred by the adults when depositing their eggs.

The hatching takes place at night, five or six days after the eggs are deposited. The young larva breaks from the egg at the end near the micropylar projection, which is the cephalic end of the embryo, and readily finds its way to the water, usually by dropping directly from the egg mass or the object to which it is attached.

The freshly hatched insect differs from the more mature larva in having the lateral filaments relatively much longer, and the head larger; and the antennae only two segmented.

The young are not very active and will remain in the portion of the stream below the egg mass for several months or probably longer if not carried away by the strong current. A muddy bottom is not distasteful to them, though they may be found in many parts of our common streams; they are less frequently found in the swiftest parts. The species (*C. serricornis*)

with the long caudal breathing tubes have been found only in stagnant or quiet water.

The larvae are carnivorous, and do their feeding chiefly in the dark. The large larvae readily eat smaller ones of their own species, and larvae of *Sialis*, caddis worms, small dipterous larvae, and other accessible forms with soft bodies. Weed [1889] says that a larva in an aquarium ate *Notonecta undulata*, house flies, and a spider.

The length of the larval period has not been definitely determined. It may be judged from the data already known that it is about three years. The amount of increase at each molt, if found from a number of examples, would furnish data for determining the number of molts. The number of molts compared with the average time between molts would determine rather closely the larval period. The great difficulty in the way of determining the number and average time of the molts, is that they can not easily be cared for and fed in their exact natural conditions through a long period and their increase at each molt carefully measured. Larvae if fed well will doubtless molt more rapidly than those which are poorly fed. I kept larvae alive in running water from Sep. 2, 1899, to June 1, 1900. Only two of them molted during that period, but they were very poorly fed.

Young larvae which hatched June 15 to 20, 1899, over a quiet part of a brook where the bottom was a large, flat rock deeply covered with sediment, were found in great numbers and of nearly uniform size four months later, at the close of the warm season. It is from these and from the range of sizes observed at one place as the result of one day's collecting, that I have thought the larval period must be about three years.

When fully fed and of proper age, the larva leaves the water, makes a cell in rotten wood, in the earth, or under a stone or even in mud, where it sheds the last larval skin to assume the pupal form.

The pupae are difficult to find, as they are often far from water and may be buried several inches in the ground. The

length of the pupal stage has not yet been exactly determined, but the period is probably not longer than two weeks. Walsh and Weed both mention *C. rastricornis*, as being found under bark of the upper side of logs floating in water. They were doubtless there to pupate. Weed speaks of the pupa stage of that species as lasting eight days in one case and 14 days in another case. H. L. Moody [1878] notes that a specimen of *C. pectinicornis* spent 12 days in the pupa stage.

The pupae are quiescent but can crawl when disturbed. The color is at first light brown but becomes dark before the emergence of the adult insect. As in the case of *Sialis* and *Corydalid*, the pupae very much resemble the adults in many points of external structure. Walsh says of pupae of *C. rastricornis*, that at least the female has two robust obtuse abdominal appendages, about 2mm long, confluent at base; and an inferior process of two similar ones, connate throughout.

The adults are better fliers than *Sialis*, but are still very awkward and are not difficult to catch. They are chiefly crepuscular, but often fly in the late morning, and are easily frightened from their diurnal hiding places along a wooded stream. Specimens taken to cages have all died in a very short time, and it is probable that the life in the winged state is only a few days. They have not been known to take food in this state.

Adults of *C. serricornis* have been collected at Ithaca from June 9 to 18 in various years.

#### KEY TO SPECIES OF CHAULIODES

- a* Wings black or brown with white markings
  - b* A continuous, broad, somewhat arcuate white band extending across the middle of each wing almost attaining the hind margin of each; antennae serrate in the female, flabellate in the male ..... 1 *fasciatus*
  - bb* An irregular band of white spots, generally broadest in front, extending across the middle of each front wing, on the hind wing represented by only a few minute dots which may be wanting; antennae more or less serrate in both sexes [pl.52]..... 2 *serricornis*

- aa* Wings somewhat ashy in color with more or less dusky markings
- b* Veins of fore wings marked with dark and light uniformly alternate
- c* Antennae of both sexes serrate; prothorax with pale line in middle behind..... 3 *rastricornis*
- cc* Antennae of both sexes pectinated..... 4 *pectinicornis*
- bb* Veins of fore wings uniform in color except where the dusky markings cross them
- c* Head yellow behind by the confluence of the smooth areas
- d* Antennae brown..... 5 *angusticollis*
- dd* Antennae blackish..... 6 *concolor*
- cc* Head with the smooth areas dark brown or blackish
- d* Antennae black; alar expanse 50 to 65 mm.. 7 *minus*
- dd* Antennae brown; alar expanse 75 to 100 mm
- e* Area about ocelli much depressed; antennae of male about equal in length to head and thorax; those of female much shorter ..... 8 *disjunctus*
- ee* Area about ocelli not depressed; antennae of male densely bristly, as long as body.. 9 *californicus*

## DESCRIPTION AND GEOGRAPHIC RANGE OF SPECIES

1 *C. fasciatus* Walker

- 1853 *Chauliodes fasciatus* Walker, Cat. Brit. Mus. Neur. p.201
- 1861 *Chauliodes serriicornis* Hagen, Synopsis Neur. N. Am. p.190
- 1863 *Chauliodes lunatus* Hagen, Ent. Soc. Phila. Proc. 2:180
- 1863 *Chauliodes lunatus* Walsh, Ent. Soc. Phila. Proc. 2:262
- 1869 *Chauliodes fasciatus* McLachlan, Ann. and Mag. Nat. Hist. (4), 4:40
- 1892 *Chauliodes lunatus* Banks, Am. Ent. Soc. Trans. 19:357

General color dark brown or black; head rufous, the disk fuscous, head of male more slender and more highly colored, back of head with flat, rufous streaks; prothorax with impressed rufous spot each side, that of the male more slender and more highly colored; legs luteofuscous, tarsi duller in color; antennae black, serrate in female, flabellate in male, each joint with a large oval plate underneath; wings brownish black, fore pair

with a broad white band, pointed with fuscous, not attaining the posterior margin; one or more apical marginal spots, some cross veins bordered with white; posterior pair with a broad arcuate white band not attaining the posterior margin, and a large rounded basal white spot, also a small apical spot and sometimes the cross veins bordered with white. Length to tip of wings 35 to 40 mm; alar expanse 60 to 70 mm. The males are the more highly colored on the head and thorax, and the dark part of their wings is more uniformly black.

The inferior appendage of the male is elongated, narrower at tip, and of a pale brown color. The males are the smaller.

When the wings of this species are spread, the white arc across their center is nearly continuous from one to the other.

New York, Pennsylvania, Glen Echo D. C., Maryland, Sugar Grove O., Illinois, Lake of the Woods, Missouri, Arkansas, Mexico.

## 2 *C. serricornis* Say

- 1824 *Chauliodes serricornis* Say, Long's Exp. 2:307  
 1839 *Chauliodes serricornis* Burmeister, Handb. Ent. 2:949  
 1842 *Neuromus maculatus* Rambur, Hist. Nat. Neur. p.442, pl.10, fig.2  
 1853 *Hermes maculatus* Walker, Cat. Brit. Mus. Neur. p.202  
 1859 *Chauliodes serricornis* Say, Am. Ent. LeConte ed. 1:206  
 1861 *Chauliodes maculatus* Hagen, Synopsis Neur. N. Am. p.191  
 1863 *Chauliodes serricornis* Hagen, Ent. Soc. Phila. Proc. 2:180  
 1863 *Chauliodes serricornis* Walsh, Ent. Soc. Phila. Proc. 2:262  
 1869 *Chauliodes serricornis* McLachlan, Ann. and Mag. Nat. Hist. (4) 4:40  
 1892 *Chauliodes serricornis* Banks, Am. Ent. Soc. Trans. 19:357  
 1892 *Chauliodes serricornis* Say, Banks, Am. Ent. Soc. Trans. 19:357  
 1901 *Chauliodes serricornis* Needham, N. Y. State Mus. Bul. 47, p.549, pl.27

Body black; back of head with flat, ferruginous streaks and spots which are sometimes black; prothorax fuscous, impressed each side; legs and feet nigro-fuscous; antennae serrate in both sexes; inferior appendage of male is of a shining black at tip; wings black, a transverse interrupted white line in middle of front wings, widest at anterior margin, not attaining the pos-

terior margin; hind wings in middle with a few minute white dots which may be wanting; some white apical spots in both wings, these often united in hind wing to form larger white apical areas. Length to tip of wings 30 to 38 mm; alar expanse 45 to 55 mm [pl.52, fig.1].

Massachusetts, New York, Pennsylvania, Washington D. C., Maryland, Georgia; in Ohio along tributaries of the Muskingum in Knox county; in Minnesota at St Cloud, St Johns and Minneapolis.

### 3 *C. rastricornis* Rambur

- 1842 *Chauliodes rastricornis* Rambur, Hist. Nat. Neur. p.444  
 1853 *Chauliodes rastricornis* Walker, Cat. Brit. Mus. Neur. p.198  
 1853 *Hermes indecisus* Walker, Cat. Brit. Mus. Neur. p.204  
 1861 *Hermes pectinicornis* Linnaeus, Hagen, Synopsis Neur. N. Am. p.189  
 1861 *Chauliodes rastricornis* Hagen, Synopsis Neur. N. Am. p.189  
 1863 *Chauliodes rastricornis* Hagen, Ent. Soc. Phila. Proc. 2:181  
 1863 *Chauliodes rastricornis* Walsh, Ent. Soc. Phila. Proc. 2:263  
 1869 *Chauliodes rastricornis* McLachlan, Ann. and Mag. Nat. Hist. (4), 4:40  
 1892 *Chauliodes rastricornis* Banks, Am. Ent. Soc. Trans. 19:357  
 1901 *Chauliodes rastricornis* Needham, N. Y. State Mus Bul. 47, p.546

General color luteo-cinereous; head behind with flat, black streaks and spots; prothorax with a slight impression on the middle behind, a flexuous impressed stripe each side; legs luteous, tarsi fuscous; antennae of both sexes serrate; front wings subcinereous, obscurely clouded with fuscous, veins marked with dark and light uniformly alternate; hind wings cinereous. Length to tip of wings 45 to 55 mm; length of body 5 to 50 mm; alar expanse 65 to 80 mm.

New York, Pennsylvania, South Carolina, Georgia, western Florida, Sullivan Ind., Illinois, Missouri.

4 *C. pectinicornis* Linnaeus

- 1763 *Hemerobius pectinicornis* Linnaeus, Amoen. Acad. 6:412 and Centures Insector, p.29, 87
- 1767 *Hemerobius pectinicornis* Linnaeus, Syst. Nat. ed. 12. p.911
- 1773 *Hemerobius pectinicornis* DeGeer, Mem. Ins. 3:562, t. 27, fig.3
- 1773 *Hemerobius virginienensis* Drury, Ill. Nat. Hist. v.2, Apx.
- 1775 *Hemerobius pectinicornis* Fabricius, Syst. Ent. p.309
- 1781 *Semblis pectinicornis* Fabricius, Sp. Ins. 1:386; and 1787. Mantissa Ins. 1:244; and 1793. Entom. Syst. 2:72.
- 1805-21 *Hemerobius pectinicornis* Palisot, Ins. Afr. and Am. Neur. t. 1, fig.2
- 1807 *Chauliodes pectinicornis* Latreille, Gen. Crust. and Ins. 3:198
- 1836-49 *Chauliodes pectinicornis* Cuvier, Règne Animal, p.14; t. 105, fig.2
- 1837 *Hemerobius pectinicornis* Drury, Ins. Westw. ed. 1:105, t. 46, fig.3
- 1839 *Chauliodes pectinicornis* Burmeister, Handb. Ent. 2:950
- 1842 *Chauliodes pectinicornis* Rambur, Hist. Nat. Neur. p.444
- 1853 *Chauliodes pectinicornis* Walker, Cat. Brit. Mus. Neur. p.198
- 1861 *Chauliodes pectinicornis* Hagen, Synopsis Neur. N. Am. p.189
- 1861 *Chauliodes virginensis* Hagen, Synopsis Neur. N. Am. p.190
- 1869 *Chauliodes pectinicornis* McLachlan, Ann. and Mag. Nat. Hist. (4), 4:40
- 1869 *Chauliodes virginienensis* McLachlan, Ann. and Mag. Nat. Hist. (4), 4:40
- 1892 *Chauliodes pectinicornis* Banks, Am. Ent. Soc. Trans. 19:357
- 1892 *Chauliodes virginienensis* Banks, Am. Ent. Soc. Trans. 19:357
- 1901 *Chauliodes pectinicornis* Needham, N. Y. State Mus. Bul. 47, p.547; also pl.26, fig.1 (erroneously named)

General color luteo-cinereous; hind part of head with yellowish, flat streaks and spots; prothorax with a middle stripe behind yellowish, and a yellow flexuous stripe each side; legs yellowish, tarsi fuscous; antennae fuscous, pectinated; front wings grayish, often obscurely clouded, transversely streaked with fuscous; veins fuscous, uniformly interrupted with white; radial sector with six or seven branches; hind wings grayish; cross veins between all the branches of radius in front wings,

about 20 to 22. Length to tip of wings 45 to 60 mm; alar expanse 58 to 90 mm. The female is the larger.

New England, New York, Ohio, Detroit Mich., Wisconsin, central Missouri, Maryland, Virginia, South Carolina, Florida, Louisiana.

5 *C. angusticollis* Hagen

1861 *Chauliodes angusticollis* Hagen, Synopsis Neur. N. Am. p.191

1869 *Chauliodes angusticollis* McLachlan, Ann. and Mag. Nat. Hist. (4), 4:40

1892 *Chauliodes angusticollis* Banks, Am. Ent. Soc. Trans. 19:357

General color fusco-testaceous; mandibles yellow; head small, yellow behind by the smooth spots and streaks blending together, black across between the eyes; ocelli yellowish white; prothorax narrow, a fulvous stripe in the middle posteriorly and a lateral one each side; legs fuscous; antennae of female nearly filiform, brown; those of male nearly moniliform, clothed with brown bristles, the two basal joints nearly smooth; appendages of male stout, obtuse, oblique; wings gray much marked with brownish black points and patches scattered over the front wings and costal and distal areas of the hind ones; cross veins between all the branches of radius in front wings, about nine to 11; radial sector of same pair with four to five branches. Length to tip of wings 35 to 42 mm; alar expanse 55 to 70 mm.

Georgia, Virginia, Kentucky, Illinois.

6 *C. concolor* n. sp.

Body dusky; head light yellow behind by the fusing of the smooth shining stripes and areas; prothorax longer than wide, narrower than the head; a brown median line behind, and irregular brown marks each side; ocelli light colored; antennae nearly black, rather long, nearly moniliform, clothed with short bristles beyond the basal joint; legs brown, feet dusky; wings cinereous with numerous small dusky markings, specially on front pair and costal area of hind pair; veins mostly dark and each of nearly uniform color throughout; a transverse dusky line near base of front wings; in the front pair, cross veins

between all the branches of radius, about seven to 10, and radial sector with five branches. Length to tip of wings 45 to 55 mm; alar expanse 70 to 85 mm.

Ithaca N. Y. The dates on all specimens in Cornell collection, so far as they are dated, are in the latter half of July.

The species is most like *C. californicus* in general appearance, but differs in color of the hind part of the head, color of the antennae and feet, and in other minor points.

#### 7 *C. minimus* n. sp.

Body color blackish; mandibles black; head small, black, with smooth raised streaks and spots behind black; prothorax black, very narrow, smooth raised places almost wanting; legs and feet black; antennae very slender, filiform to moniliform, black, nearly equaling the body in length; wings much like those of *C. californicus* in color and markings; the front pair with cross veins between all branches of radius, about seven, and radial sector divided into five branches. Length to tip of wings about 28 to 35 mm; alar expanse 50 to 65 mm.

San Rafael Cal. Types in Museum of Comparative Zoology.

#### 8 *C. disjunctus* Walker

1866 *Chauliodes disjunctus* Walker, Lord's Naturalist in Vancouver isl. 2:334

1869 *Chauliodes disjunctus* McLachlan, Ann. and Mag. Nat. Hist. (4), 4:40

General color brown, often with cinereous hairs; mandibles with black tips; head dark rufous, thickly punctured, hind part with long, shining, dark streaks, some of which are not continuous; prothorax rather long and much narrower than the mesothorax; legs lightest toward the body, varying in color from blackish to yellowish brown; antennae very short, brown, pilose; wings cinereous, with numerous dark brown spots and dots, some of which form incomplete transverse lines most marked on front wings; that pair with some of the spots collected into about five costal patches, some very dense basal spots; radial sector of front wings with five to six branches; cross veins between all the branches of radius, about seven to nine. Length

to tip of wings 75 to 90 mm; alar expanse 90 to 125 mm. This species includes the largest members of the genus found in the new world.

Vancouver island; in California at San José, and near Alder Creek, Sacramento co.

### 9 *C. californicus* Walker

- 1853 *Chauliodes californicus* Walker, Cat. Brit. Mus. Neur. p.199  
 1861 *Chauliodes californicus* Hagen, Synopsis Neur. N. Am. p.190  
 1869 *Chauliodes californicus* McLachlan, Ann. and Mag. Nat. Hist. (4), 4:40  
 1892 *Chauliodes californicus* Banks, Am. Ent. Soc. Trans. 19:357

Body brownish black; mouth parts rufous, mandibles often with only one tooth below the apex; hind part of head rufous with flat, somewhat shining streaks and spots; prothorax behind with a flexuous, obsolete, rufous stripe, the middle elevated and more obsolete; legs brown; antennae brown, stout, long as body in male, much longer than head and thorax in female; those of the male densely covered with bristles, giving a feathered appearance; two basal joints naked; wings cinereous, veins of front pair transversely lined with the fuscous markings of the cells which cross them; from costal margin of all the wings a basal brownish black streak, and sometimes apical ones; other brown spots often present, specially on the front wings; in front pair, cross veins between all the branches of radius, about seven to nine; and radial sector with five branches. Length to tip of wings 45 to 60 mm; alar expanse 75 to 100 mm.

Mariposa and in Siskiyou county, Cal. and Reno Nev.

### 10 *C. cinerascens* Blanchard

- 1851 *Chauliodes cinerascens* Blanchard, Gay, Hist. Chile, v.6, Neur. pl.2, fig.10  
 1861 *Chauliodes chilensis* Hagen, Synopsis Neur. N. Am. p.321 (*nomen nudum*)  
 1869 *Chauliodes cinerascens* Blanchard, McLachlan, Ann. and Mag. Nat. Hist. (4), 4:41

General color ashy; head pale variegated; prothorax rugose, a pale line behind; legs and feet same color as abdomen, wings

cinereous, front pair dusky spotted all over, spots minute and more obscure at costal margin, some spots larger; hind pair slightly spotted. Length of body 20mm. (The figure measures 26mm); length to tip of wings about 55mm; alar expanse 75 to 80mm.

In Chile at Valparaiso and Valdivia. Blanchard said, *Esta especie parece rara en Chile*.

I have seen no specimens of this species, and therefore I quote Blanchard's description:

Ch. omnino cinerascens; capite pallido-variegato; prothorace rugoso, linea postica pallida; alis cinereis, anticis undique fuscomaculatis, maculis minutis margine costali obscurioribus, non-

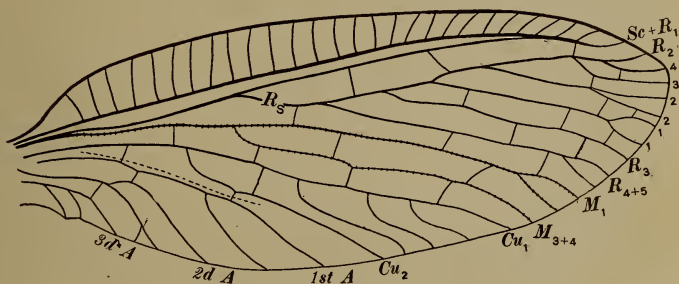


Fig. 25 Fore wing of *Neuromus pallidus* x2

nullis majoribus; alis posticis leviter maculatis; pedibus abdomineque concoloribus. Longit., corpor. 10 lin; enverg. alar., 30 lin.

Hagen afterward said his species equals *C. cinerascens* Blanchard.

### NEUROMUS Rambur

**Adult.** Color from nearly black to light yellow; usually somewhat smaller than *Corydalis* adults; mandibles of male never elongated nor annular as in *Corydalis*. Cheek once or twice toothed or with a sharp angle. Prothorax quadrangular to cylindric, narrower than the head, longer than broad and shorter than the mesothorax and the metathorax combined. Three large approximate ocelli facing outward. Antennae always filiform or nearly so, and usually not longer than the head and thorax combined. Medius with more than two branches [fig.25]; cross veins between branches of radius, from 10 to 30, but the number is rather constant in each species;  $Cu_1$  with one or two accessories in some species, to four or five in others.

**Larva.** No published account of *Neuromus* larvae has appeared. They are doubtless very rare in the United States, and

when found have probably been mistaken for larvae of *Corydalis*.

There are two lots, or 14 unnamed specimens, from the Himalaya region, in the Museum of Comparative Zoology, sent from Kullu, by M. M. Carleton, a missionary, some years ago. (One lot dated 1872). These I consider are larvae of *Neuromus*, as they differ materially from the *Corydalis* larvae so familiar to us, and as adult specimens of *Neuromus* were sent by the same collector from the same region, and *Corydalis* has never been reported from that part of Asia.

They are distinguished from *Corydalis* (1) by the *black* ring about the spiracles; (2) by the antennae being only five jointed as in *Chauliodes* larvae; (3) by the abdominal gill tufts being more distinctly peduncled.

They have eight pairs of abdominal spiracles, one well developed pair and one rudimentary pair on the thorax; seven pairs of tracheal gill tufts. The body above is very black with the clavate projections. These are found distributed over the more flexible parts of the body and filaments. Lateral filaments eight pairs, with a row of tufted hairs on dorsal side of six front pairs, more tufts on the others. The head and thorax are dark without distinct markings. Prothorax longer than wide and as wide as the head; eyes each with six ocelli; labial palpi with three joints above the base.

The larvae appear much like those of *Chauliodes*, but the presence of the tracheal gill tufts excludes them from that genus, while the black ring and center of each spiracle, as well as the five jointed antennae, separate them quickly from *Corydalis*.

**Eggs.** The eggs of this genus have never yet been recognized, but we would expect them to be most like those of *Corydalis*.

#### TABLE TO SPECIES OF NEUROMUS

<i>a</i> Sides of head with alate bidentate process....	1 <i>seror</i>
<i>aa</i> Sides of head only once toothed or only slightly angled	
<i>b</i> Front wings with white dots in most of the cells back of the costal region.....	2 <i>cephalotes</i>
<i>bb</i> Front wings not marked as above	
<i>c</i> Head black, wings brown in distal half...	3 <i>maculipinnis</i>
<i>cc</i> Head and body yellowish; wings mostly yellowish; dark markings on the prothorax	
<i>d</i> Front wings spotted with black or brown posteriorly, and with their cross veins mostly dark; metathorax often marked with black or brown..	4 <i>hieroglyphicus</i>

- dd* Front wings not spotted with dark;  
 cross veins dark or not; metathorax  
 not marked with black or brown  
*e* Cross veins of fore wings more or less  
 darkened (brown or black)  
*f* Dark markings on prothorax dis-  
 tinct; media of fore wings with  
 six branches; cross veins between  
 all branches of radius, 25 to 30.. 5 *corripiens*  
*ff* Dark markings on prothorax indis-  
 tinct; media of fore wings with  
 3 (?) branches; cross veins be-  
 tween all branches of radius, 10  
 to 12..... 6 *winthem i*  
*ee* Cross veins of fore wings not darkened 7 *pallidus*

## DESCRIPTION AND GEOGRAPHIC RANGE OF SPECIES

1 *N. soror* Hagen

1861 *Corydalis soror* Hagen, Synopsis Neur. N. Am. p.193

General color luteous; mandibles brown; cheeks with alate bidentate process; head broad, not depressed, a brownish stripe each side; prothorax narrower than head, longer than broad, each side with a brownish border; legs lurid with knees and apex of tarsi obscurer; antennae short, slender, black, the two basal segments yellowish; appendages of male four, superior ones forcipated, clavate at apex; inferior ones cylindric, extremely short; wings luteo-subhyaline, an obsolete band on the middle of front pair, and fuscous spots nearer the apex; veins fuscous, luteous on the middle of the costal space; cross veins between all branches of radius, about 18 to 21; medius of fore wing four branched;  $Cu_1$  with four to five accessories. Length to tip of wings 60 to 75mm; alar expanse 85 to 130mm.

Mexico, Cordova.

2 *N. cephalotes* Rambur

1842 *Corydalis cephalotes* Rambur, Hist. Nat. Neur. p.441

1853 *Corydalis cephalotes* Walker, Cat. Brit. Mus. Neur. p.208

1861 *Corydalis affinis* Hagen, Synopsis Neur. N. Am. p.321  
*(nomen nudum)*

1866 *Corydalis hecate* McLachlan, Jour. of Ent. 2:499, pl.20

Color of body dark brown, mandibles and mouth parts reddish brown; head dark brown, roughened behind but not marked

with lighter color; cheek with sharp tooth; prothorax longer than broad, blackish brown, hastate groove same color; femora dusky, tibiae and tarsi yellowish; antennae slender, filiform, brownish yellow, blackish at tips, about equal to head and thorax in length; appendages of male four, superior pair thin, nearly flat, not angled at the end, shorter than the inferior ones; wings dull brown with white dots in cells, and mostly black on costal region of front pair, and white areas in stigma and back of medius in middle of wing; cross veins mostly dark, even in the costal region; mediums of fore wing with four to five branches; cross veins between all branches of radius about 18 or 19;  $Cu_1$  with three to four accessories. Length to tip of wings 70 to 80 mm; alar expanse 105 to 145 mm.

Brazil.

### 3 *N. maculipinnis* Gray

1832 *Hermes maculipinnis* Gray, Griffith's ed. of Cuvier, 2:331, pl.72, fig.1

1842 *Neuromus ruficollis* Rambur, Hist. Nat. Neur. p.443

1853 *Hermes ruficollis* Walker, Cat. Brit. Mus. Neur. p.202

1853 *Hermes maculifera* Walker, Cat. Brit. Mus. Neur. p.203

1861 *Corydalus illota* Hagen, Synopsis Neur. N. Am. p. 321 (*nomen nudum*)

1869 *Hermes maculipinnis* Gray, McLachlan, Ann. and Mag. Nat. Hist. (4), 4:39

Nearly black; mandibles black; sides of head convex, toothed angle wanting, only slightly angled on each side, back of head with black or brown shining streaks and dots, two long streaks in center, other smaller ones each side; prothorax narrower than head, longer than broad, lurid, darker at each side of center; legs and feet ferruginous; antennae longer than the thorax, slender, slightly serrated in both sexes; wings ferruginous, hyaline, white in basal part of both pairs, or in the front pair the two colors are mixed toward the base; a white spot in radio-medial region about three fourths the way out; other white spots and blotches between these spots and the white areas; media of fore wing with six branches; cross veins between all branches of radius, about 18 to 30;  $Cu_1$  with two accessories

in both pairs of wings of both sexes. Length to tip of wings 38 to 48 mm; alar expanse 65 to 80 mm.

Brazil.

#### 4 *N. hieroglyphicus* Rambur

- 1842 *Neuromus hieroglyphicus* Rambur, Hist. Nat. Neur.  
p.442  
1853 *Hermes hieroglyphicus* Walker, Cat. Brit. Mus. Neur.  
p.206  
1861 *Corydalis hieroglyphicus* Hagen, Synopsis Neur. N. Am.  
p.194  
1869 *Neuromus hieroglyphicus* McLachlan, Ann. and Mag.  
Nat. Hist. (4), 4:45

Pale yellow; mandibles brown; cheeks convex, one toothed; head with two black spots behind, which fade out in some specimens; prothorax cylindric with four black or brown spots or marks; mesothorax with sometimes two to four similar marks; feet yellow, base and apex of tibiae and apex of tarsi black; antennae short, black with bases yellow; appendages of male four, superior ones the longer, apex recurved; inferior ones stout, apex clavated; wings yellowish hyaline, cross veins in front pair partly black, and those wings marked posteriorly with more or less distinct black spots; media of fore wings with three branches; cross veins between all branches of radius, about 10 to 17;  $Cu_1$  with 1 to 2 accessories. Length to tip of wings 40 to 65 mm; alar expanse 65 to 90 mm.

Mexico, Central America, Brazil, Venezuela.

#### 5 *N. corripens* Walker

- 1860 *Hermes corripens* Walker, Ent. Soc. Lond. Trans. n. s. 5:180  
1861 *Corydalis livida* Hagen, Synopsis Neur. N. Am. p.321 (*nomen nudum*)  
1869 *Neuromus corripens* McLachlan, Ann. and Mag. Nat. Hist.  
(4), 4:45

General color testaceous; mandibles black, marked with dark brown; head black between the ocelli; heads slightly angled; prothorax narrower than the head, almost linear; two elongated black dots on each side, the fore pair sometimes almost obsolete; legs yellow above, darker below, tarsi blackish; antennae simple, black, testaceous toward the base; wings whitish hyaline, veins testaceous, fore pair with the cross veins more or less

black, costa very convex; media of fore wings with six branches; cross veins between all branches of radius, about 28 to 30;  $Cu_1$  with three accessories. Length to tip of wings 60 to 65 mm; alar expanse 90mm.

Brazil.

6 *N. winthemi* n. sp.

Yellowish; mandibles reddish brown; head brownish yellow, lighter on hind part, side of head one toothed; prothorax longer than broad, dark marking indistinct; legs light yellow, last tarsal segment blackish; antennae not seen; wings whitish hyaline; veins yellow; fore pair with the cross veins and angles of veins more or less brown; cross veins between all branches of radius about 11 or 12;  $Cu_1$  with two accessories. Length of body 32mm; to tip of wings 55mm; alar expanse 90mm.

Brazil. Collected by Winthem. Type in the Hagen collection, Museum of Comparative Zoology.

7 *N. pallidus* n. sp.

Light yellow; mandibles brownish; ocelli partly ringed with black; behind each side of head a brown raised mark; cheek with a single tooth; prothorax longer than wide, a brown interrupted streak each side, not reaching the caudal margin of the segment; legs and feet light yellow, claws darker; antennae filiform and hairy; wings transparent, obscured in the stigmatal region of all four wings; a few white scales and hairs along the veins; cross veins, at least toward base of fore wings, somewhat darkened; about 12 to 14 cross veins between all the branches of radius; media of fore wings with three branches;  $Cu_1$  with two accessories. Length to tip of wings about 40mm; alar expanse 60 to 65 mm [pl. 52, fig. 3].

Type in United States National Museum, Washington, catalogue no. 5176; probably native of Mexico.

**CORYDALIS** Latreille

**Adult.** This genus includes the largest insects of the order. Yellow-fuscous, 40 to 60 mm long from base of jaws to end of abdomen, males usually the larger; wings fuscous with black and yellow veins; white dots always found in some of the cells

of the fore wings. Prothorax quadrangular, much narrower than the head and shorter than the mesothorax and the metathorax combined; large toothlike angles on the back part of the sides of the head; three large approximate ocelli facing at about  $120^\circ$  from each other; antennae filiform moniliform or slightly serrate in a few species, as long as, or much longer than the head and thorax combined; mandibles prominent, not concealed by the labrum when closed, those of the male more or less elongated and annular, incurved, suited only for clasping. Wings numerous veined, the accessory veins of the radial sector extending backward from  $R_2$  in both pairs of wings, and media has more than two branches [fig. 26]; hind wings broad at base and folded in the anal area when at rest; wing expanse 100 to

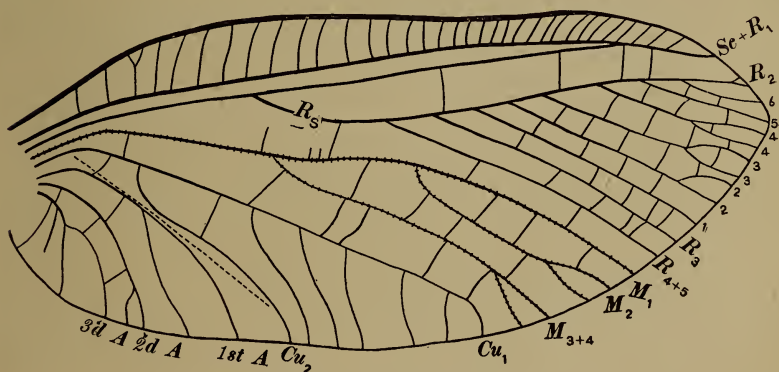


Fig. 26 Fore wing of *Corydalus cornuta* x2

150mm. Tarsi cylindric; male caudal appendages long and usually strongly forcipate; in the female they are short and simple.

**Larva.** When full grown, the larva is about 80 to 90 mm long. The general color is dusky; the head and thorax are supplied above with pretty figured markings; the whole body is supplied with black clavate projections except in the intersegmental folds and on the parts heavily clothed with chitin. The last four or five segments of the abdomen taper toward the caudal end of the body. The first eight segments of the abdomen are each provided with a pair of unjointed lateral filaments, 6 to 7 mm long, somewhat clothed with hairs; the first seven of these segments are each provided with a pair of ventral tufts of tracheal gills. Spiracles are found on each of the first eight abdominal segments and on the fold between the prothorax and the mesothorax, and a rudimentary pair on a fold between the mesothorax and the metathorax. On the last abdominal segment are

a pair of slightly two jointed anal prolegs, each with a pair of strong, slender claws and a lateral filament. The antennae have six segments, the basal joint being united with the head, though Walsh and Riley recognized only five segments.

*Corydalid* larvae collected from different localities have been examined. As they show some variations, a few notes on them may aid in future work of determining the species.

Label, "Colorado, Chiquili, Dr Newbery, 1873." Has no tufts of hairs on the lateral nor anal filaments. The spongy tufts are sessile as in *C. cornuta*. Some tufts of hairs near the spiracles on the sides of the abdomen; some yellow markings on dorsal aspect of abdomen.

Label, "Texas, Stolley, no. 1640." Has two rows of hairy tufts on most of the lateral and on the anal filaments. Thorax and head brown with some light yellow areas; abdomen dark above with no yellow markings; mesothorax and metathorax same color as the prothorax.

Label, "Mobile Ala., 1853." Has tufts the same as the above specimen, but the abdomen is very dark, and the clavate projections are usually long. Mesothorax and metathorax same color as the abdomen; prothorax and head reddish brown without the striking light markings; lateral and caudal filaments nearly white above.

Label, "Rio Negro, Amazon, Thayer Exp." (about 1869). Has the six jointed antennae, and the marks of *C. cornuta* on the head and thorax. It differs from that species in that the spongy tufts stand out ventrally from the abdomen, as a pair of fan-shaped tufts to each segment.

Label, "Himalaya, Sutlej river, Billispor M. M. Carleton, 1872." Very light brown or yellowish; reddish yellow on the thorax and head. The eight pairs of lateral filaments are clothed on the ventral side with tufts appearing like the tracheal tufts. A similar growth fringes the abdominal segments. Antennae six jointed; ocelli six on each side.

**Eggs.** The egg masses of *Corydalid cornuta* were described by Riley [1877] who found them in the middle of July 1876, along the banks of the Mississippi. His description I quote:

"The egg mass of *Corydalid cornuta* is either broadly oval, circular, or (more exceptionally) even pyriform in circumference, flat on the attached side, and plano-convex on the exposed side. It averages 21mm in length, and is covered with a white or cream-colored albuminous secretion, which is generally splashed around the mass on the leaf or other object of attachment. It contains from two to three thousand eggs, each of

which is 1.3mm long, and about one third as wide, ellipsoidal, translucent, sordid white, with a delicate shell, and surrounded and separated from the adjoining eggs by a thin layer of the same white albuminous material which covers the whole. The outer layer forms a compact arch, with the anterior ends pointing inward, and the posterior ends showing like faint dots through the white covering. Those of the marginal row lie flat on the attached surface; the others gradually diverge outwardly so that the central ones are at right angles with said object. Beneath this mantled layer the rest lie on a plane with the leaf, those touching it in concentric rows; the rest packed in irregularly. Before hatching, the dark eyes of the embryo show distinctly through the delicate shell, and the eggs assume a darker color, which contrasts more strongly with the white intervening matter.

The egg-burster (*ruptor ovi*) has the form of the common immature mushroom, and is easily perceived on the end of the vacated shell."

Prof. Riley's description of the "egg-burster" agrees exactly with the appearance of the micropylar projection, and this is the only appendage I have found on the eggs either before or after the larvae have hatched [fig.20].

The eggs are found on trees, vines, leaves, stones, bridges, etc, usually over running water, but sometimes at a very short distance to one side of the stream.

### Life history of *Corydalis cornuta*

Riley and others have given accounts of the life history of this species, but by careful tracing I have been able to add a few points.

The young larvae of an egg mass all hatch in a single night, crawl from under the mass and soon drop or crawl to water. The young differ from the older larvae in having relatively larger heads and mouth parts, only three jointed antennae, and relatively longer filaments and legs. Riley observed that they lack the ventral spongy tracheal tufts. These tufts do not appear till a later molt. Riley therefore concluded that these tufts are for the purpose of adhering to stones, and not for breathing. The structure of these (showing tracheae), the absence of other suitable gills, the regular movements of the tufts when a larva is actively respiring, as when placed in water from which the air has escaped—all these indicate the true purpose of the tufts.

The larvae live at the bottom of streams of rapid water in the swiftest parts, under stones. They readily feed on soft bodied caddis worms, *Sialis* larvae, very young *Chauliodes* larvae, younger members of their own species; and doubtless have a wide range of food habits. I have succeeded in getting hungry larvae to eat bits of fresh beef by placing them in a tray of water in a photographic dark room. They do not feed well when exposed to bright light; and they seem to prefer live food. In the dark room they will sometimes eat large dipterous larvae.

They spend the winter some distance below the bed of the stream buried in the sand and gravel.

The larvae usually crawl when they care to move about in the water, but they can swim backward readily and sometimes are found to swim forward.

Nothing very definite is known as to the number of molts or as to the length of the larval period. The same problems are here involved as those stated on a preceding page in speaking of *Chauliodes* larvae. I have kept larvae of *Corydalus* over winter in running water in dark cells made of flowerpots. Out of 28 which were kept alive in the cells for nine months, only two were found to molt, and these do not warrant the drawing of any general conclusion. In September 1899 I took from one locality in Fall creek, Ithaca, over 100 larvae and measured their heads. The range of sizes was so gradual that it gave no clue to the probable number of years represented in the lot.

Though the larvae naturally live in beds of streams till full grown, they are capable of living out of water in moist soil for an indefinite length of time. I thus kept them in a breeding cage in a greenhouse for over four months, at the end of which they were accidentally killed. The larval spiracles are doubtless open and functional, at least when the insect is out of water, and may be used for breathing from air which collects under stones in running water.

The mature larvae leave the water in May or June and pupate in cavities under flat stones near the stream. At times they crawl for many rods and even up high banks before selecting

a suitable place to pass the pupa state. Walsh gives an account of the crawling of the mature larvae to the top of a chimney of a small house by the Mississippi river.

When the last larval skin is shed, the pupa is very light brown or nearly white, but gradually becomes darker up to the end of the period. The pupa very much resembles the adult in external structure, specially as regards the antennae, tarsal segments, wing pads, and absence of lateral filaments, spongy tufts and prolegs. There is great variation in the appearance of the warty prominences left by the bases of the filaments.

The length of the pupal life was determined by daily observation of specimens which had just crawled from the water to find a nest for the pupal life. The transformations of 25 specimens were thus noted. It was found that the time spent in the nest before the larval skin is shed varies from about one day to as much as two weeks. The time from this last molt till the adult emerges, or the actual life of the pupa, is not so variable, as the table will show.

No. of larvae observed	Date of molting larval skin	Date of emerging as adults	Days in pupal life
4	May 29	June 8	10
5	May 28	June 4	7
12	May 29	June 7	9
2	June 7	June 14	7
1	June 9	June 23	14
1	June 12	June 26	14

It will be noticed from the table that the length of life in this state varies from seven to 14 days with an average of nine days in the specimens observed. Many (perhaps 10 or 15) others, which I observed, died during that state. This was probably partly due to the fact that they were handled too much, or became too dry in the cages where they were kept, but I have often found dead pupae under stones on banks of streams.

The adults are perhaps as good fliers as *Chauliodes*, and both of these will make longer flights than *Sialis*; both are often found at great distance from streams, while *Sialis* seldom

wanders far from water. *Corydalis* is usually crepuscular, and is often attracted to lights at night. One large female was seen to make a flight of several rods, when apparently unmolested, on a bright, hot June day at 2 o'clock p. m.

The adults are very short-lived, at least when kept in cages, and probably also when at large, judging from the short length of the season when adults are to be found. Of the specimens kept in cages, the males never lived longer than three days after emerging, while the females lived as long as eight or 10 days. None could be induced to take food, and it is probable that the adults take no food. The studies made by Mr W. A. Riley and others indicate that very little histolysis takes place in the digestive organs. This is explained by the probable fact that these organs are not used in the adult insect.

The dates on which adult specimens have been taken at Ithaca range from June 4 to July 8, in a long series of years.

#### TABLE TO SPECIES OF *CORYDALIS*

<i>a</i> Hastate or lanceolate pale mark on middle of hind part of prothorax, irregular light marks each side	
<i>b</i> Costal cells of front wings mostly with two white spots in each	
<i>c</i> Male appendages, upper pair, with the ends abruptly turned under and back, appearing as a separate segment.....	<i>1 in amabilis</i>
<i>cc</i> Male appendages, with upper pair not abruptly turned backward .....	<i>2 cornuta</i>
<i>bb</i> Costal cells of front wings with only one white spot in each.....	<i>3 cognata</i>
<i>aa</i> Hastate and other marks on prothorax of same color as the rest or nearly so	
<i>b</i> Antennae with two basal joints and most of the others light yellow, outer three fourths with minute sharp teeth	
<i>c</i> Front wings with no dusky clouds in cells, except near the stigmatal region; white dots almost wanting .....	<i>4 crassicornis</i>
<i>cc</i> Front wings with dusky and white clouds; white dots numerous except in costal region..	<i>5 peruviana</i>
<i>bb</i> Antennae with basal joints never yellow; segments of antennae never toothed	
<i>c</i> Costal cells often with two white dots in each	
<i>d</i> Front wings hardly clouded except in region of stigma .....	<i>6 lutea</i>

<i>dd</i> Front wings densely clouded in many places, specially just back of $R_1$ .....	7 <i>batesii</i>
<i>cc</i> Costal cells with only one or no white dots	
<i>d</i> Front wings with dark circle near the fork- ing of media; triangular white spot at stigma .....	8 <i>nubila</i>
<i>dd</i> Front wings not marked as above.....	9 <i>armata</i>

## DESCRIPTION AND GEOGRAPHIC RANGE OF SPECIES

1 *C. inamabilis* McLachlan

1868 *Corydalus inamabilis* McLachlan, Linn. Soc. Jour. 9:235,  
pl.8, fig.3

Pale brown; abdomen pale fuscous; palpi black, with broad whitish yellow annulations; mandibles long, slender, finely rugose, pale brown with apical portion black; head yellowish brown, anterior margin nearly black; finely rugose above, beneath, and posteriorly with coarsely reticulated spaces; ocelli yellow; eyes plumbeous; caudal portion of head with impressed streaks and spots; prothorax longer than broad, slightly widened posteriorly; upper surface convex, pale brown, hastate median impression behind; roughened raised places along the sides; legs and feet pale yellowish brown, tarsi and tips of tibiae darker; antennae scarcely shorter than body, pale brown, three or four terminal joints black, basal joints bulbous, joints beyond basal fourth with a short triangular acute tooth; appendages of the male long, yellowish, slightly pilose; superior pair sinuate, the tips bent under and somewhat retuse; inferior pair geniculated, apexes directed upward and slightly dilated; wings long and narrow, subacute, cinereo-subhyaline; front pair with white dots in cells everywhere except in the costal area, Sc area with fuscous spaces, stigmatic region slightly yellowish, C-Sc cross veins black except those near the middle, which are whitish in the center; all discal and apical cross veins black; longitudinal veins yellow, subcosta and radius marked with fuscous; hind wings hardly paler, cross veins of discal and apical areas black, those in basal discal region yellow; front wings with about 26 cross veins between all branches of radius, media with four branches,  $Cu_1$  with three accessories. Alar expanse 100mm; body without appendages 35mm; mandibles of male 26mm.

Waco and Dallas Tex.

2 *C. cornuta* Linnaeus

- 1758 *Hemerobius cornutus* Linnaeus, Syst. Nat. ed. 10. p.551  
 1767 *Raphidia cornuta* Linnaeus, Syst. Nat. ed. 12. p.916  
 1773 *Hemerobius cornutus* DeGeer, Mém. Ins. 3:559, pl.27, fig.1  
 1781 *Hemerobius cornutus* Fabricius, Sp. Ins. 1:392; and 1787.  
     Mantissa Ins. 1:246  
 1788-93 *Hemerobius cornutus* Linnaeus, Syst. Nat. ed. 13. 5:2639  
 1791-1825 *Corydalis cornuta* Olivier, Encycl. Meth. 7:59  
 1793 *Hemerobius cornutus* Fabricius, Syst. Ent. 2:81  
 1805-21 *Corydalis cornuta* Palisot, Ins. Neur. pl.1, fig.1  
 1807 *Corydalis cornuta* Latreille, Gen. Crust. and Ins. 3:199  
 1836-49 *Corydalis cornuta* Cuvier, Règne Animal, p.14, pl.104  
 1839 *Corydalis cornuta* Burmeister, Handb. Ent. 2:950  
 1848 *Corydalis cornutus* Holdemon, Acad. Bost. Jour. p.158, pl.1-3  
 1861 *Corydalis cornuta* Hagen, Synopsis Neur. N. Am. p.192;  
     1863. Ent. Soc. Phila. Proc. 2:181  
 1863 *Corydalis cornuta* Walsh, Ent. Soc. Phila. Proc. 2:265  
 1892 *Corydalis cornuta* Banks, Am. Ent. Soc. Trans. 19:357  
 1901 *Corydalis cornuta* Needham, N. Y. State Mus. Bul. 47, p.550,  
     pl.28

General color luteo-fuscos to luteo-cinereous: head large, broad, sides convex, hind part with impressed yellow spots and streaks surrounded by fuscous, each side with oblique yellow stripe beneath; mandibles never concealed by the labrum, those of the male normally much elongated and annulated; prothorax much narrower than head, longer than broad, a light colored hastate mark in the middle of the hind part, irregular yellow flat points each side; legs brownish, knees, apex and incisions of tarsi fuscous; antennae nearly moniliform, long, fuscous; superior pair of male appendages forcipated, infracted at the apex, dolabriform; wings subcinereo-hyaline; veins darker, often black, specially at their angles; C-Sc cross veins pale in middle; cells mostly supplied with white dots, the costal ones each with two white dots; in fore wing cross veins between all branches of radius, about 25 to 35, media with three to four branches, and Cu<sub>1</sub> with four to five accessories. Length to tip of wings about 75mm; alar expanse 100 to 140 mm. The size in both sexes is variable.

Quebec, New England, New York, Pennsylvania, Maryland, Washington D. C., Virginia, North Carolina, South Carolina, Ohio, Illinois, Missouri, Kansas, Minnesota.

3 *C. cognata* Hagen1861 *Corydalis cognata* Hagen, Synopsis Neur. N. Am. p.1931892 *Corydalis cognata* Banks, Am. Ent. Soc. Trans. 19:357

General color luteous yellow; head large, broad, sides convex, marked behind with two punctate ochraceous streaks, and a few obsolete points; prothorax, almost quadrangular, a little narrower than the head, marked behind with a hastate mark in the middle and ochraceous points each side; feet and legs lurid, apex of tarsi obscurer, claws fuscous; wings yellowish hyaline, cross veins dark, front wings with a dark marking on base and apex of costal area,  $R_1$  clouded fuscous, costal cells with one white dot, number of dots in other cells several, cross veins between all the branches of radius about nine to 11, medius with three branches,  $Cu_1$  with three accessories. Length to tip of wings 55 to 60 mm; alar expanse 80 to 100 mm.

New Mexico, Phoenix Ariz.

4 *C. crassicornis* McLachlan1868 *Corydalis crassicornis* McLachlan, Linn. Soc. Jour. 9:233, pl.8, fig.2

Body pale brown to yellowish; head very broad, flattened above, finely rugose, blackish around the ocelli, front margins black, ocelli yellow, head marked behind with three impressed reticulated spaces; palpi black; mandibles of male very long, blackish tubercles on inner edges, color same as head but darker near the tips; prothorax scarcely longer than broad, hardly dilated behind, brownish with front margin blackish, the hastate median mark behind, and raised spaces each side of about the same shade as the prothorax; mesothorax and metathorax nearly equal in width to each other and to the prothorax or slightly narrower than the hind margin of it; legs pale brown, tarsi, knees, and parts of the tibiae dark fuscous; antennae as long as the body or longer, thick, brown, sutures black, three to four terminal joints black, basal joints bulbous, joints beyond basal fourth with a short, straight, triangular tooth beneath; appendages of male very long, slightly pilose; superior pair nearly cylindric at base, tips dilated and truncated but suddenly

bent downward and produced toward the body into a short process; inferior pair not half so long, cylindric, curved upward at the tips; wings cinereo-hyaline, front pair with white dots in the cells, stigmatic region dark, subcostal region often dark fuscous and with paler spaces, veins yellowish, cross veins mostly black except the middle part of many toward the center of C-Sc, cross veins between all the branches of radius about 17 or 18, medius with three branches, Cu<sub>1</sub> with four accessory veins; hind wings scarcely paler than the others, subcostal area clouded, some of the cross veins dark. Length of body without appendages about 45mm; alar expanse 120 to 135 mm.

San Antonio Tex.

5 *C. peruviana* n. sp.

Body brown; head brown, finely rugose behind; mandibles darker than the head; prothorax much longer than broad, the median hastate mark behind concolor, roughened areas along each side reaching the whole length; legs and feet of same shade as the head; antennae of female slender, brown, black toward the tips; those of male stout, very long, slightly toothed, minute papillae all over, bright yellow, bases yellow, outer end black; wings subcinereo-hyaline, cross veins mostly darkened, a few of those in costal region lighter in the middle; white and dusky clouds from stigma across to middle of Cu<sub>1</sub>, no white dots in the costal cells and none at all on the hind pair of wings; in front pair, cross veins between all the branches of radius, about 28 to 30, media with four branches, Cu<sub>1</sub> with five accessory veins. Length to tip of wings 80 to 85 mm; alar expanse about 130mm.

Types in Museum of Comparative Zoology; female from "head waters of Rio Rimac, Peru, in the Cordilleras"; male labeled "Guatamala purchase."

6 *C. lutea* Hagen

1861 *Corydalislutea* Hagen, Synopsis Neur. N. Am. p.193

1861 *Corydalisvetula* Hagen, Synopsis Neur. N. Am. p.321 (*nomen nudum*)

1861 *Corydalis armigera* Hagen, Synopsis Neur. N. Am. p. 321 (*nomen nudum*)

General color luteous; head large, broad, ferruginous, the sides convex, marked behind with obsolete luteous spots; prothorax much narrower than head, longer than broad; sides of middle obsoletely impressed; concolor or luteous spots behind and at the sides; legs lurid, base of tibiae and some tarsal segments nigro-fuscous; antennae slender, light yellow to brown, dark at outer end; superior male appendages cylindric, long, oblique, truncated at apex; inferior ones recurved at the apex, clavate; wings subcinereo to luteo hyaline; cross veins dark except the middle part of those of costal region; veins luteous, partly fuscous; a few white dots, usually only one to a cell; front pair with cross veins between all branches of radius about 25, media with three branches,  $Cu_1$  with four to five branches. Length to tip of wings 55 to 85 mm; alar expanse 110 to 140 mm.

Vera Cruz, Mexico, Brazil, Cordova, Spain.

#### 7 *C. batesii* McLachlan

1868 *Corydalis batesii* McLachlan, Linn. Soc. Jour. 9:232, pl.8, fig.1

Color of body brown, or dusky on the abdomen; head above and beneath dark brown; mandibles of female black at tips; palpi black; head marked behind with five punctures, front margin yellow; ocelli yellow; eyes dark olivaceous; prothorax longer than broad, scarcely dilated behind, sides nearly parallel, very convex above, smooth, dull brown, with three short impressed concolor spaces behind; mesothorax and metathorax scarcely broader than the prothorax, pale brown; legs finely pilose, fuscous, paler beneath, all tarsi and the apical part of the tibiae yellowish, specially behind; antennae yellow with black tips, very slender, not toothed, not over two thirds the length of the body; wings long and narrow, front pair ashy, dusky area beyond the middle, many blackish blotches in front portion, one at stigmatic region, several in subcostal region, and others back of the radius, white dots in the cells, several angles of the veins black, cross veins mostly black except the middle parts of those in the basal half of costal region; hind

pair broader and paler than the other, some dusky clouds and black veins and cross veins near front margin.

Ega, Brazil. Type, a female, in McLachlan's collection.

### 8 *C. nubila* Erichson

1848 *Corydalís nubila* Erichson, Schomburgk, Reise Guiana, 3:583

1861 *Corydalís nubila* Hagen, Synopsis Neur. N. Am. p.321

Body dark brown to brownish yellow; head broader than the prothorax, brown on the sides back of the eyes, roughened behind; prothorax rather narrow, dull brown, concolor; legs and feet light brown; antennae black, slender, slightly toothed as in *C. crassicornis*, a little longer than head and thorax in the female; superior pair of male appendages bent downward; front wings subcinereo-hyaline with brown shade above anal area, a dark oval spot about the first branching of medius and white dots near by, a white triangular cloud at stigma reaching nearly through cell  $R_1$ , no white dots in costal region, cross veins mostly dark; medius with four branches, cross veins between all the branches of radius, about 20 to 22; hind wings more yellowish, and no white dots in the cells. Length to tip of wings about 60mm; alar expanse 75 to 100 mm.

British Guiana, Venezuela. One female from the latter country in the Harvard museum.

### 9 *C. armata* n. sp.

1861 *Corydalís armata* Hagen, Synopsis Neur. N. Am. p.321  
(*nomen nudum*)

1842 *Corydalís cornuta* Rambur, Hist. Nat. Neur. p.440

1853 *Corydalís cornuta* Walker, Cat. Brit. Mus. Neur. p.208

Body brown; head brown, finely rugose; mandibles brown, with three teeth besides the apex in females; thorax longer than broad, brown all over, the median hastate mark behind concolor roughened areas along each side reaching the whole length of the segment; legs and feet lighter than the head in color; antennae slender, brown, black toward the outer end; wings subcinereo-hyaline, veins fuscous, cross veins mostly darkened, those of costal region mostly light in center; front pair dusky in stigmatic region, and sometimes near the first branching of

radius, cells of costal region partly with one white spot, never two, other cells of front pair and in apical region of hind pair with white dots; cross veins between all branches of radius in front pair, about 30 to 31, media with four branches,  $Cu_1$  with five or six accessory veins. Length to tip of wings 75 to 85 mm; alar expanse 110 to 140 mm.

Republic of Colombia, Venezuela, Chapada, Brazil, "S. Catharina, Theresopolis, Fruhstorfer, 1887." Several specimens in the Museum of Comparative Zoology.

*C. ancilla* Hagen, Synopsis Neur. N. Am. p.321 (*nomen nudum*), must still remain undescribed, as the only known specimen is in the Hagen collection and is too much injured for use. This specimen is from Paraguay, and it is hoped that other specimens may be discovered there.

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